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The Role of Nanomaterials in Nanoarchitecture

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Abstract

Nanotechnology offers potential solutions to many problems using emerging nanotechniques. Nanotechnology is expressed as revolutionary discipline in terms of its possible impact on industrial and construction applications. Depending on the strong interdisciplinary character of nanotechnology there are many research fields and several potential applications that involve nanotechnology. Obviuosly it can't provide an exhaustive report of the developments in building materials, nanoscience and nanotechnologies in all scientific and engineering fields. Nanomaterials can define to nanostructured components with at (less than 100nm). Materials with one dimension in the nanoscale are layers, such as a thin films or surface coatings. Materials that are nanoscale in two dimensions are nanowires and nanotubes. Materials that are nanoscale in three dimensions are particles quantum dots. Nanocrystalline materials, made up of nanometre-sized grains, also fall into this category. The findings of this paper are expected to benefit introduce to nanomaterials based on dimensions and the principal factors cause the properties of nanomaterials to differ significantly from other materials: increased relative surface area, and quantum effects that these factors can change or enhance properties in building materials and nanoarchitecture applications.

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1. Introduction

1.1 One-Dimensional Nanomaterials

One-dimensional (1D) nanomaterials such as engineered surfaces and thin films are used for more than a decade in various fields like chemistry, electronic device manufacturing and engineering. They have

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also found use in the silicon integrated-circuit industry where devices depend upon 1D nanomaterials for their operations. Another application of ID nonmaterial is in monolayers that are used extensively in chemistry. The properties of such layers along with their formation can be studied from the atomic level upwards; for that matter, even in lubricants, complex layers. Many researches have been conducted and developments made in the control of the composition and smoothness of surfaces and the growth of thin films. 1D nanomaterials such as engineered surfaces with specific attributes such as specific reactivity are used regularly in a variety of applications like as catalysts and in fuel cells. Why nonomaterials are used extensively in a variety of applications is owing to their large surface area and their ability to self assemble on any support surface. Many industries incur benefits from using 1D nanomaterials, such as surpassing the obvious economic and resource saving by achieving higher activity and greater selectivity in reactors and separation processes to enable small-scale distributed processing (making chemicals as close as possible to the point of use). The chemical industry has already made this move toward betterment by making use of 1D nanomaterials. Another use of such materials in the chemical industry is the on-site, small-scale production of high-value chemicals such as pharmaceuticals.

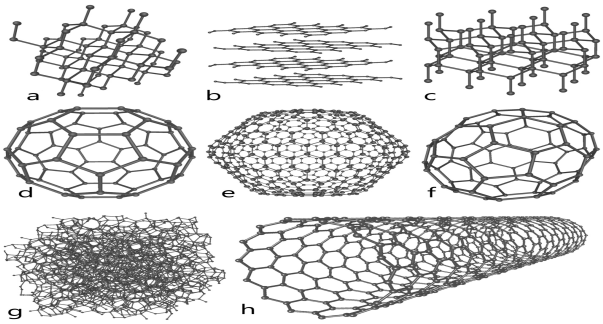

Fig.1. Type of Nanomaterials based on Dimensions

1.2 Two Dimensional Nanomaterials

Many 2D nanomaterials such as wires and tubes have also generated a lot of interest in the scientific community in past few years. In fact, their mechanical properties along with electrical properties have drawn in a lot of research.

1.3 Carbon Nanotubes

A new era in material sciences was started when carbon nanotubes were discovered in 1991. These molecules exhibit exceptional mechanical, electronic and magnetic properties and have been noted to be 100 times stronger than steel but their weight to be one-sixth of a nanotube fiber. Because nanotubes have the ability to conduct electricity and heat much better than copper, they have been extensively used in polymers to enhance their conductivity and have also been used in the antistatic packaging industry.

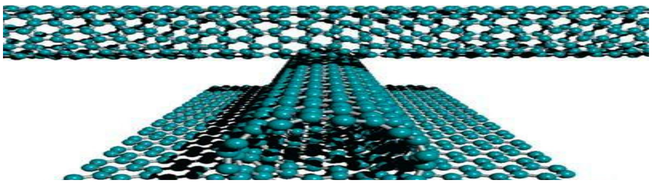

Fig. 2. Carbon Nanotubes

1.4 Nanowires

Nanowires, on the other hand, are very narrow threads, width less than 50nm, that are used in nanoscale electrical devices. The objective to use them is to produce such small electronic chips that are cheaper and which can be used in any way. In the biomedical industry, nanowires can be used in extremely sensitive biosensors that identify molecules associated with a disease or even the binding of chemicals to any target drug.

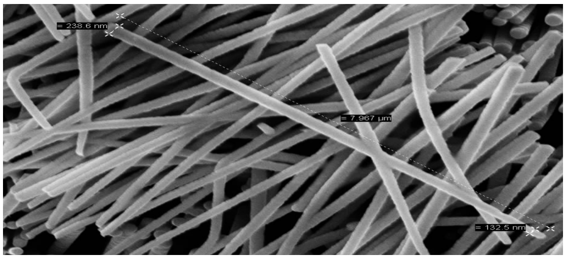

Fig. 3. Nanowires

2. Three Dimensional Nanomaterials

2.1 C60/Fullerenes

In the year 1996, Rick Smalley, Sir Harry Kroto and Robert Curl had won a Nobel Prize for their study on the synthesis of a new form of carbon, C60, which they called "buckminsterfullerene", named in honor of Buckminster Fuller, the famous architect who pioneered the geodesic dome (as seen at the Eden Project in Cornwall, left). These C60 molecules are also referred to as buckyballs. In the architecture industry, geodesic domes are famous for their lightness and strength. However, the same applies to buckyballs too. It is seen that when buckyballs are fired at a stainless steel plate at 15 000 mph, they just bounce off the stainless steel plate. And when buckyballs are compressed to 70 per cent of their original size, they become two times as hard as diamond. A fuzzyball, where all carbon atoms are combined with hydrogen, is found to be more slippery than Teflon and is used to coat bowling balls.

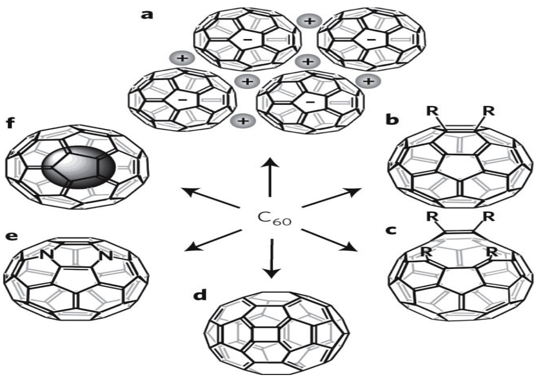

Fig. 4. Three Dimensional Nanomaterials

2.2 Nanoparticle

In nanotechnology, a particle is defined as a small object that behaves as a whole unit in terms of its transport and properties. A particle is also classified according to many parameters such as size: diameter, fine particles cover a range between 100 and 2500 nanometers, while ultrafine particles, on the other hand, are sized between 1 and 100 nanometers. Similarly for ultrafine particles, nanoparticles are sized between 1 and 100 nanometers, though the size limitation can be restricted to two dimensions. Nanoparticles may or may not exhibit size-related properties that differ significantly from those observed in fine particles or bulk materials. Nanoclusters have at least one dimension between 1 and 10 nanometers and a narrow size distribution. Nanopowders are agglomerates of nanoparticles, ultrafine particles or nanoclusters. Nanocrystals are nanometer-sized single crystals or single-domain ultrafine particles. "NanoCrystal" is a registered trademark of Elan Pharma International (EPIL) used in relation to EPIL's proprietary milling process and nanoparticulate drug formulations. Research in nanoparticles is currently an area of intense scientific research because of their wide use in various applications in biomedical, electronic and optical fields. The National Nanotechnology Initiative has led to generous public funding for nanoparticle research in the United States and will play an altruistic role in the future of this nanoparticles.

References

Leydecker, S. (2008), Nano Materials in Architecture, *Interior Architecture and Design,* Birkhauser.

Singh Nalwa, H. (2002), Nanostructured Materials and Nanotechnology, *Academic Press*.

Desmond Bernal, J. (1964), The Bakerian Lecture, The Structure of Liquids. *Proceedings of the Royal Society* 208: 299–322.

Niroumand, H., Zain, M.F.M., Jamil, M. (2011), Hill development by Earth architecture. *International Journal of Physical Sciences*, 6 (6), 1249-1256

Niroumand, H. (2011), Nanotechnology in Architecture. *Academic Publishing*, Germany

Niroumand, H., Zain, M.F.M., Jamil, M. (2012), *Advanced Materials Research*. 457-458, 354-357

Niroumand, H., Zain, M.F.M., Jamil, M. (2012), *Advanced Materials Research*. 457-458, 395-398

Niroumand, H., Zain, M.F.M., Jamil, M. (2012), *Advanced Materials Research*. 457-458, 403-406

Niroumand, H., Zain, M.F.M., Jamil, M. (2012), *Advanced Materials Research*. 457-458, 399-402

Niroumand, H., Zain, M.F.M.(2012), Nano-Clay in Rammed Earth Wall (NCREW). Patent Pending. Malaysia (2012).